Missouri Department of Natural Resources
Water Protection Program

Total Maximum Daily Loads (TMDLs)

Second Nicolson Creek
Barton County, Missouri

Completed: March 12, 2004
Approved June 9, 2004

Total Maximum Daily Load (TMDL)
For Second Nicolson Creek
Pollutant: Sulfate

Name: Second Nicolson Creek

Location: Barton County near Mindenmines, Missouri


State map showing location of watershed

Hydrologic Unit Code (HUC): 10290104

Water Body Identification (WBID): 1319

Missouri Stream Class: P1[1]

Beneficial uses: Livestock and Wildlife Watering and Protection of Warm Water Aquatic Life and Human Health [associated with] Fish Consumption

Size of Impaired Segment: 3 miles

Legal Description of Impaired Segment: Section 4, Township 32N, Range 33W to Section 18, Township 32N, Range 33W

Pollutant: Sulfate

Pollutant Source: Many Abandoned Mine Land areas

TMDL Priority Ranking: Low

Note: Although USGS maps and the Water Quality Standards list the stream name as Second Nicolson, the 1996, 1998 and 2002 303(d) impaired waters lists had the stream spelled as "Second Nicholson" with an "h". The correct spelling is "Nicolson" and will be used as such in this TMDL document.

1.0 Background Information

Second Nicolson Creek originates west of Prairie State Park near the Kansas-Missouri state line in Barton County and flows northeast through an upper watershed dominated by grasslands with extensive areas of abandoned mine land. It is located in what is known as the Osage or Cherokee Plains. This area was not covered by glaciers and is characterized by rolling hills and plains. The Osage Plains tend to have few caves, sinkholes, or losing streams compared to the Ozarks. Typically the stream valleys are shallow and have broad floodplains.

[1] Streams that maintain permanent flow even in drought periods. See Missouri Water Quality Standards (WQS) 10 CSR 20-7.031(1)(F).

Coal mining that occurred during the 1920's has severely affected water quality in Second Nicolson Creek. Present day strip mining has strict federal regulations that require that topsoil be removed and stockpiled. After the coal seam has been exploited, the mining company is required to regrade the site with the stockpiled soil and revegetate. On abandoned mine sites such as the ones along Second Nicolson, however, no soil management regulations were in effect at the time they were mined. Soil was excavated in long, furrow-like pits. The soil was dumped along the trench with the subsoil and rocks on top and the topsoil on the bottom. As the strip mining continued, soil from the next excavation was piled into the previous trench creating pits and dumps. The dumps are a mixture of shale, sandstone and the topsoil that was stripped off the coal seams. This resulted in piles with steep slopes, dangerous highwalls, and pits filled with water. Steep slopes and large rocks create a landscape that is difficult to manage and resistant to revegetation.

The strip-mined soils along Second Nicolson are identified in the Barton County Soil Survey as "Mine Pits and Dumps". Strip-mined soils have been so disrupted that it is impossible to determine exactly which soils existed there prior to mining. Strip mined soils have special management challenges that must be addressed in order to reestablish and maintain vegetation. For instance, the Barton County Soil Survey states, "The use of Mine pits and dumps is restricted largely to grazing, woodland, wildlife and recreation. The land is better suited to these purposes than to other uses." Its Capability unit, which shows in a general way the suitability of the soil for certain crops, is VIIe-7 indicating this soil has severe limitations that makes it unsuited to cultivation. Its best use is restricted to pasture, woodland, or wildlife habitat due to high erosion potential. If protective vegetation is not maintained, the damage from erosion is severe.

Two projects were undertaken to reclaim abandoned mine land in the Second Nicolson watershed. Reclamation work within the Prairie State Park and on private property adjoining the state park occurred in 1987. About 180 acres of abandoned mine land in the center of the park posed a threat to unsuspecting hikers and motorists due to dangerous highwalls, embankments, acid impoundments, quicksand-like sediment depositions and undermined roadways.

Aerial photographs from the Soil Conservation Service (now Natural Resource Conservation Service) from 1939, 1959, 1966 and 1980 provided data to help with regrading and revegetating the abandoned mine land.

2.0 Description of the Applicable Water Quality Standards and Numeric Water Quality Target

Beneficial Uses:
The Second Nicolson Creek has the following Beneficial Uses assigned to them:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life and Human Health [associated with] Fish Consumption

Anti-degradation policy:
Missouri's Water Quality Standards include the Environmental Protection Agency (EPA) "three-tiered" approach to anti-degradation, and may be found at 10 CSR 20-7.031(2).

Tier I defines baseline conditions for all waters and it requires that existing beneficial uses be protected. TMDLs would normally be based on this tier when waters are impacted by pollutants originating before the enactment of the Clean Water Law, assuring that numeric criteria (such as dissolved oxygen and ammonia) are met to protect uses.

Tier II requires that no degradation of high-quality waters occur unless limited lowering of quality is shown to be necessary for "economic and social development." In absence of socioeconomic justification for lowered water quality, TMDLs must be based on maintaining existing water quality.

Tier III (the most stringent tier) applies to waters designated in the water quality standards as outstanding state and national resource waters; Tier III requires that no degradation under any conditions occurs. Management may prohibit discharge or certain polluting activities. TMDLs must assure no measurable increase in pollutant loading.

These TMDLs will result in the protection of existing beneficial uses, which conforms to Missouri's Tier I anti-degradation policy.

Specific Criteria and Numeric Water Quality Target:

Sulfate Standards

Sulfate and chloride are linked together in Missouri's Water Quality Standards. 10 CSR 20-7.031 Section (4)(L)1 concerns streams with 7Q10 low flow of less than one cubic feet per second (cfs). Here it states that the concentration of chloride plus sulfate shall not exceed 1000 milligrams per liter (mg/L) for protection of aquatic life.

3.0 Loading Capacity

The Loading Capacity (LC) is the greatest amount of pollutant loading that a stream can assimilate without becoming impaired. It is equal to the sum of the Load Allocation (LA), the Wasteload Allocation (WLA) and the Margin of Safety (MOS) and can be expressed as the equation:

$$\mathbf{LC = LA + WLA + MOS}$$

Second Nicolson Creek is listed on Missouri's Impaired Waters list for sulfate. However, Missouri's Water Quality Standards do not contain a numerical criterion for sulfate. Instead, the standard combines sulfate and chloride.

Sulfate

For sulfate, load capacity is the combined sulfate plus chloride standard of 1000 mg/L. Using the numeric water quality target and margin of safety, an in-stream sulfate plus chloride target of 970 mg/L should ensure that water quality standards are met and maintained in Second Nicolson Creek.

$$\mathbf{970\ mg/L(LA) + 30\ mg/L\ (MOS) = 1000\ mg/L}$$

Model Description, Assumptions, and Predictions:
Because of limited water quality and flow data in Second Nicolson Creek, modeling the natural processes in this watershed was not possible. Instead, a simple data comparison over time represents the core of this TMDL. Appendix D, Graph 1 indicates that Site 1, which is located at the upper part of the impaired segment, showed single sample exceedances in 1998, 2001, and 2002. At half a mile below the impairment (site 2), there were single sample exceedances in 2001 and 2002. At site 3 (3.5 miles below the impaired segment) there were no exceedances. However, over the period 2001 through 2003, graphs 2-4 show that the average sulfate plus chloride concentration for all sites (individually or combined) decreased substantially. During this period, the average concentration from all sites decreased by 23 percent in 2002 [(1054-809)/1054 = 23 percent] and by another 37 percent in 2003 [(809-504)/809=37 percent]. Although these reductions brought the concentration below the load allocation concentration (970 mg/L), there is not enough data to conclude that water quality standards are attained in Second Nicolson Creek.

It should also be noted that department Environmental Services Program (ESP) conducted a biological assessment study of Second Nicolson Creek in the spring of 2001. The study determined that there was no significant ($\alpha = 0.05$) difference in biological diversity and habitat assessment scores between Second Nicolson Creek and the reference stream, Little Drywood Creek. Furthermore, the report concluded that taxa richness are higher in Second Nicolson Creek than in the reference creek. This report is included in the administrative record on file at the department.

4.0 Load Allocations (Nonpoint Source Load)

The Load Allocation (LA) is the maximum allowable amount of the pollutant that can be assigned to nonpoint sources. Since the Load Capacity for Second Nicolson Creek is concentration based, discharges to the stream will be required to meet those concentration targets listed above.

Sulfate
Using the numeric water quality target and margin of safety, an in-stream sulfate plus chloride target of 970 mg/L should ensure that water quality standards are met and maintained in Second Nicolson Creek.

5.0 Wasteload Allocation (Point Source Load)

The Wasteload Allocation (WLA) is the maximum allowable amount of the pollutant that can be assigned to point sources. There are presently no point sources discharging to the affected segment of Second Nicolson Creek.

6.0 Margin of Safety

Because the modeling of the Second Nicolson TMDL consists solely of data trend analysis, no assumptions were made regarding pollutant fate and/or transport. An explicit margin of safety will be utilized expressed as a three-percent reduction of the loading capacity. The MOS includes an in-stream allocation for the chloride portion of the combined sulfate plus chloride standard. Chloride concentration in Second Nicolson Creek represents roughly one percent of the total sulfate and

chloride concentration. Therefore, the margin of safety equals 30 mg/L, that is, 0.3 mg/L chloride and 29.7 mg/L sulfate.

7.0 Seasonal Variation

Missouri's Water Quality Standards do not distinguish seasonal differences when determining applicable sulfate plus chloride water quality criteria. The TMDL for sulfate + chloride should ensure compliance with the water quality standard year-round.

8.0 Monitoring Plan

The quality assurance project plan (QAPP) for fiscal year 2004 calls for eight samples per site for the three sites listed below and shown on the location map.

ID	Site Name	WBID
1	2nd Nicolson Cr. @ Hwy P	1319
2	2nd Nicolson Cr. NE of Burgess	1319
3	Drywood Cr. West of Drywood Conservation Area	1314

The monitoring consists of field measuring water temperature, pH and conductivity, and taking grab samples for laboratory analysis of alkalinity/acidity, sulfate, and chloride. If future field data indicate that sulfate + chloride concentration is stabilized at a level equal or less than 970 mg/L, Second Nicolson Creek will be proposed for de-listing in the next 303(d) listing cycle.

9.0 Implementation Plan

Prior reclamation projects in the Second Nicolson watershed were conducted in 1987 and 1996. The Prairie State Park reclamation project reclaimed 47 acres at a cost of $933,996. The Bison Reclamation Project conducted in 1996 reclaimed 118 acres on both public and private land and cost $821,195. The work already done on Second Nicolson is expected to allow this waterbody to stay in compliance with Water Quality Standards. Further monitoring will determine whether standards continue to be met. Although past reclamation work has improved this waterbody, monitoring will determine further reclamation needs and will be addressed as future technology advances are made and program funding allows.

10.0 Reasonable Assurance

The department's Water Protection Program will continue low-flow water chemical monitoring of the impaired segment of Second Nicolson Creek. Periodic review of the department's Water Quality Management Plans and monitoring data should provide reasonable assurance that Second Nicolson Creek will meet water quality standards.

11.0 Public Participation

The water quality limited segment of Second Nicolson Creek is included on the approved 1998 303(d) list for Missouri. The Missouri Department of Natural Resources, Division of Protection

and Soil Conservation, Water Protection Program developed this TMDL. Six public meetings to allow input from the public on impaired waters were held between August 18 and September 22, 1999. No comments pertaining to Second Nicolson Creek were received during the public meetings. Groups and individuals receiving the public notice include the members of the Clean Water Commission, Water Quality Coordinating Committee, TMDL Policy Advisory Committee, Barton County Stream Team members (approximately 15), state senator and representative, and those that routinely receive the department's Permit Public Notices.

This TMDL was put on 30 day Public Notice from March 12, 2004 to April 11, 2004. No comments were received from the public.

12.0 Administrative Record and Supporting Documentation

Appendix A - Location Map
Appendix B - Land Use Map
Appendix C - Data
Appendix D - Graphs

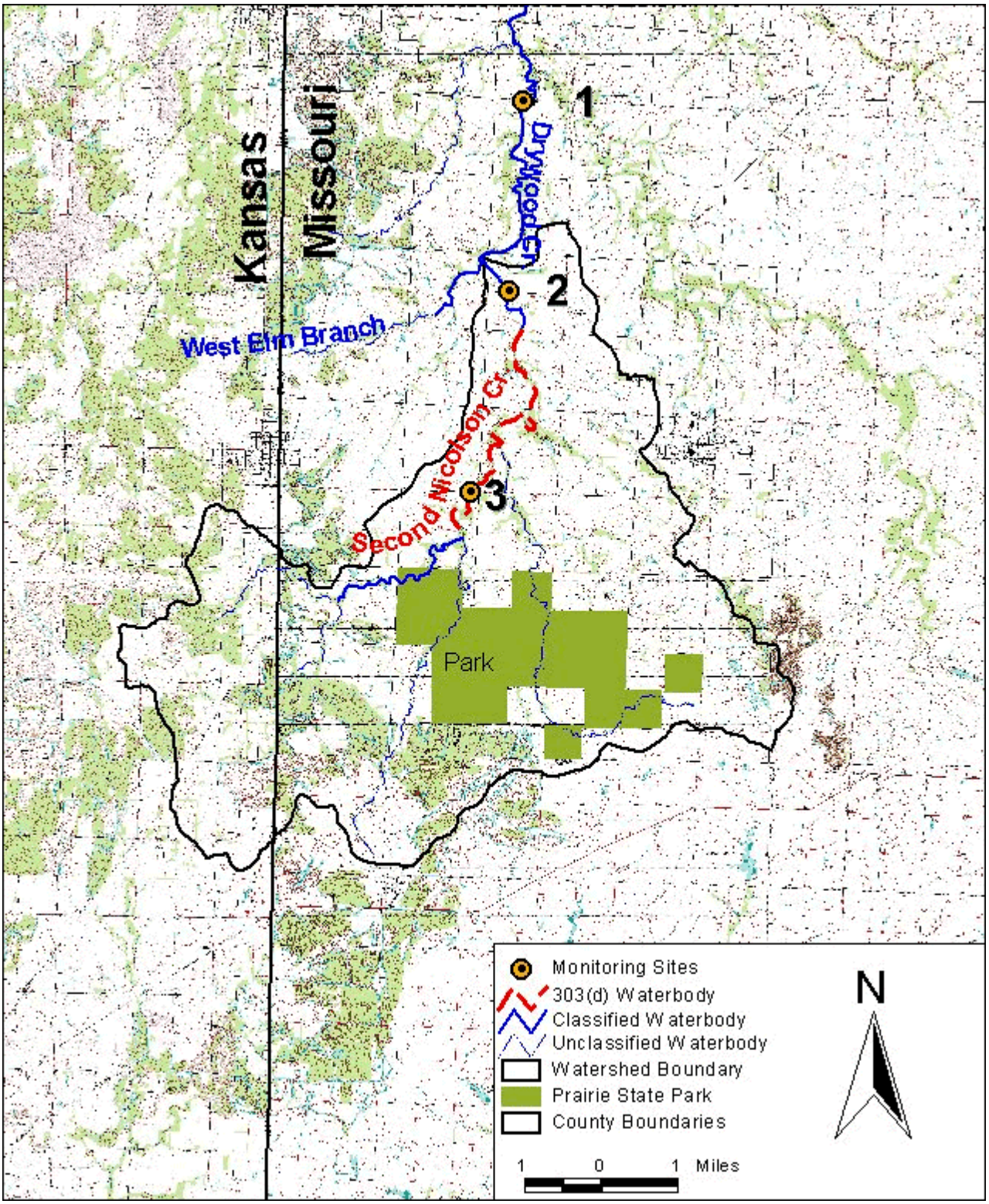
Documents on file with the department:

Public notice announcement
Biological Assessment of Second Nicolson Creek

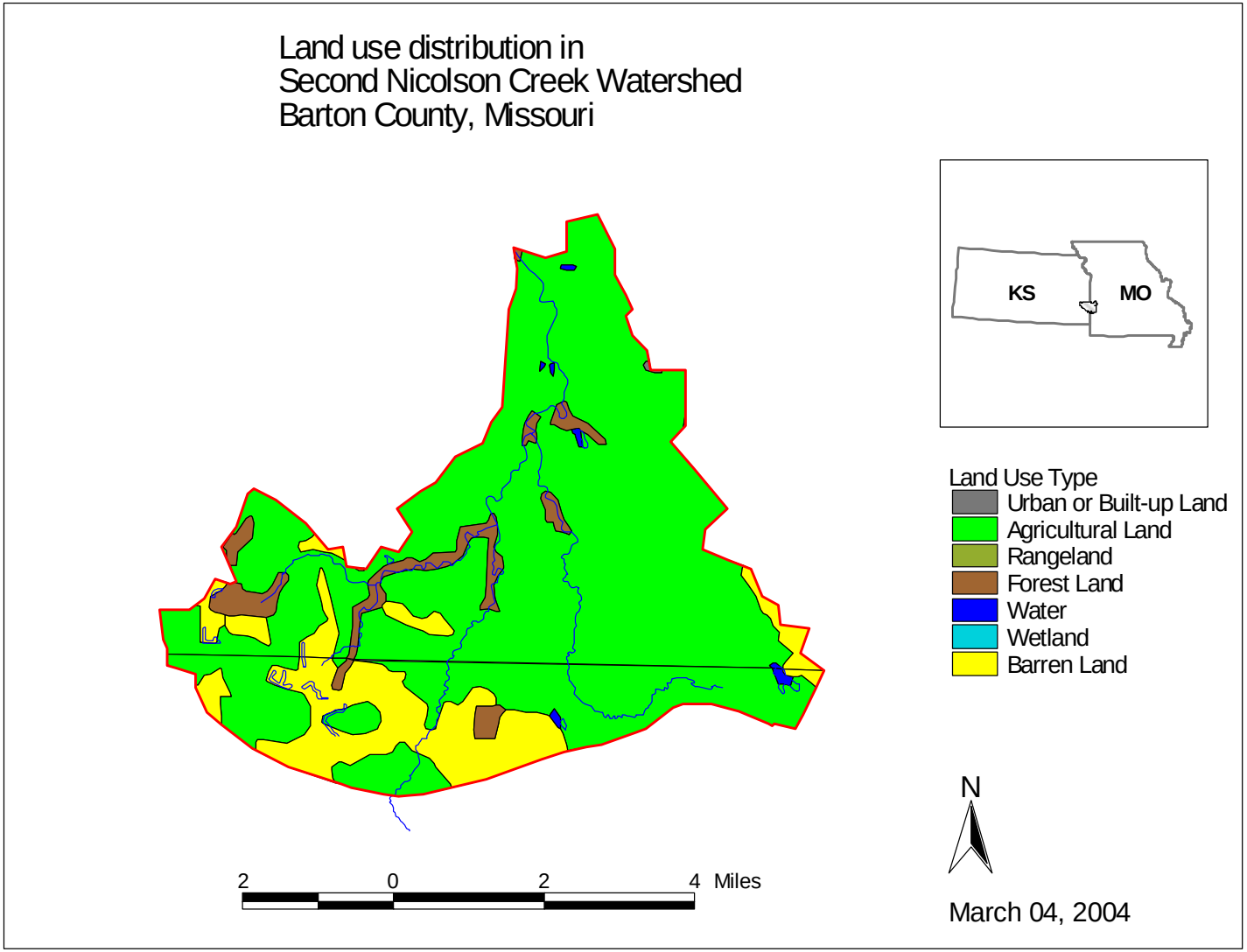
Known Basin Water Quality Studies

- "Occurrence of Selected Pesticides, Nutrients, Selected Trace Elements, and Radionuclides in Ground and Surface Water From West-Central Missouri—July 1990-March 1991," U.S. Geological Survey Open-File Report 93-362, Rolla Missouri, 1994.
- "Biological Assessment Report, Second Nicholson (sic) Creek, Barton County, Missouri Department of Natural Resources, Environmental Services Program, March 27, 2001.
- "Biological Assessment of the Macroinvertebrate Community in Sulfate Streams using Artificial Leaf Packs and Natural Non-Flow Habitat over Depositional Substrate," Missouri Department of Natural Resources, Environmental Services Program, March-May, 2001.
- "Hydrology of Area 39, Western Region, Interior Coal Province Kansas and Missouri," U.S. Geological Survey, U.S. Department of the Interior, Water-Resources Investigations Open-File Report 83-851, Kansas, 1984.

Appendix A
Water Quality Monitoring Locations



Appendix B
Land Use in the Second Nicolson Watershed



Second Nicolson Creek Land Use/Land Cover

Class	Land Use/Land Cover Type	Area in acres
1	Urban	10
2	Barren Land	3,072
3	Cropland and Grassland	16,431
4	Forest	1,037
5	Wetland	0
6	Water	71
7	Unclassified	34
	Total Watershed Area	20,655

From: MoRAP web site, SW Missouri Land Cover Data, July 2003

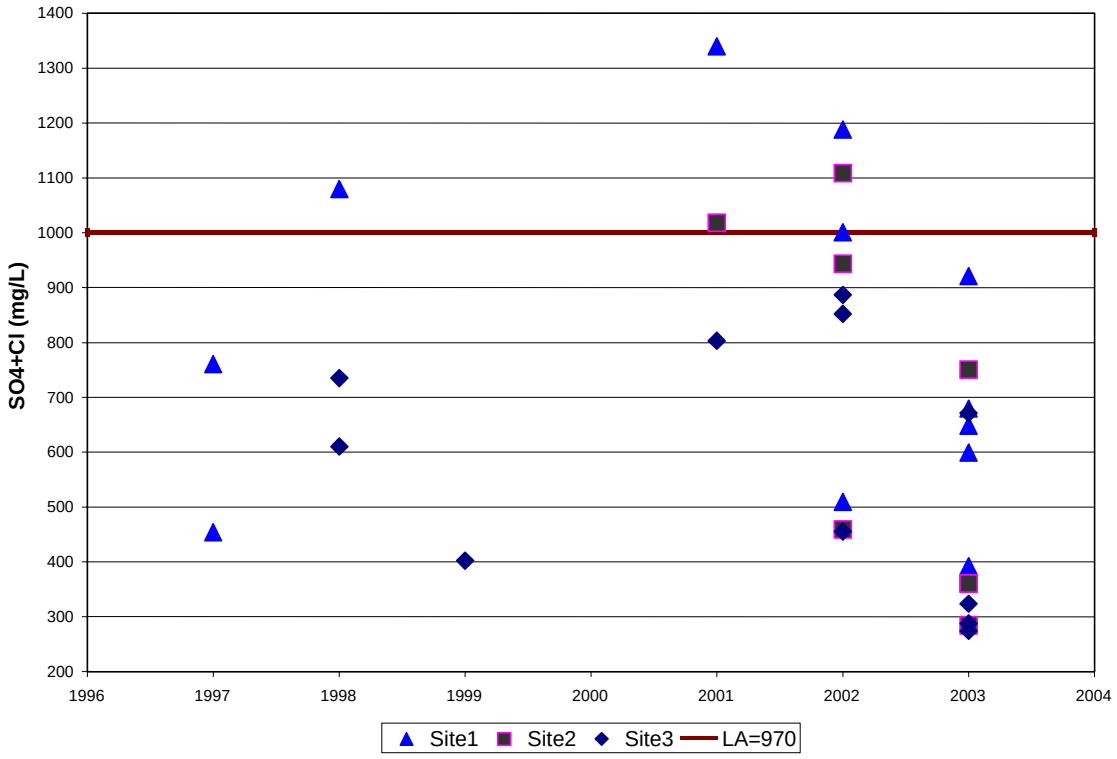
Appendix C
Water Quality Data

Site No.	Year	Mo.	Day	Time	Flow	° C	pH	SC	Alk	SO4	Cl	SO4 + Cl
1	1997	7	2			28	7.2	1042	72	448	6	454.0
1	1997	7	30		0.5	25	7.8	1632	101	758	2.499	760.5
1	1998	9	3		0.8	26	7.5	2090	120	1080		1080.0
1	2001	10	3	1405	0.4	19	7.7	2160	150	1330	9.9	1339.9
1	2002	8	12	1130		24.4	7.39	2130	140	500	9	509.0
1	2002	9	25	1215		18.5	7.4	1738	131	990	11	1001.0
1	2002	10	22	1140					141	1180	8	1188.0
1	2003	3	6	1155		7	7.7	1650	78	913	8	921.0
1	2003	4	9	850	2.5	6	7.7	937		673	6.41	679.4
1	2003	10	23	1125		16.5	7.6	1320	93	593	6.21	599.2
1	2003	10	30	1055		15.1	7.2	1380	87	642	5.9	647.9
1	2003	12	31	1105		5.7	8.72	825	62	385	7.4	392.4
2	2001	10	3	1330	0.4	19	7.5	1710	116	1010	8.5	1018.5
2	2002	8	12	1245		24.3	7.4	1857	116	449	10	459.0
2	2002	9	25	1250		20	7.3	1648	115	936	8	944.0
2	2002	10	22	1210					116	1100	9	1109.0
2	2003	3	6	1215		7	7.4	1370	67	739	12	751.0
2	2003	10	23	1145		17.5	7.64	870	72	353	7.74	360.7
2	2003	10	30	1115		16.4	7.26	857	72.5	353	7.75	360.8
2	2003	12	31	1125		5.7	8.05	635	46	276	8.59	284.6
3	1998	9	3		0.2	27	7.4	1580	112	735		735.0
3	1998	9	22			21	7.8	1300		604	6	610.0
3	1999	6	3		6.5	22.5	7.4	913	55	395	7	402.0
3	2001	10	3	1350	0.4	18	7.3	1470	99	793	10.2	803.2
3	2002	8	12	1315		23.1	7.32	1422	113	442	13	455.0
3	2002	9	25	1320		18	7.2	1558	104	878	9	887.0
3	2002	10	22	1230					118	843	9	852.0
3	2003	3	6	1235		7	7.4	1210	59	657	14	671.0
3	2003	10	23	1200		16.3	7.55	739	67.5	279	8.62	287.6
3	2003	10	30	1130		14.4	7.23	796	69	315	8.43	323.4
3	2003	12	31	1140		5.6	7.9	603	47	265	8.95	274.0

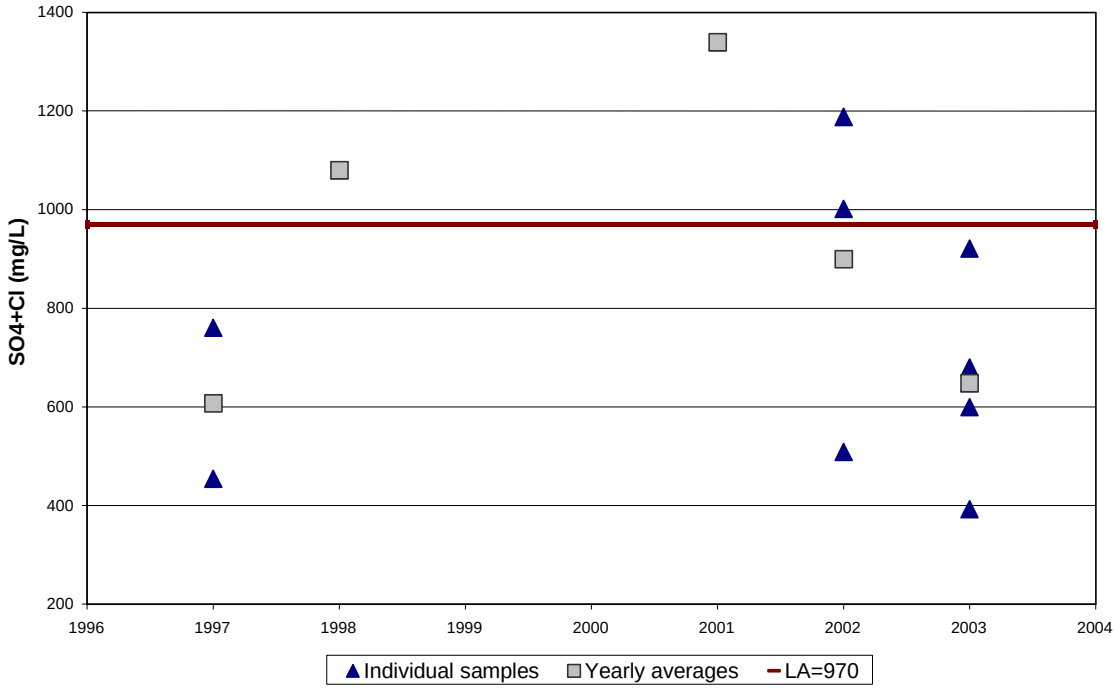
Time = In 24 hour time
Flow = In Cubic Feet per Second
° C = Temperature in degrees Celsius
pH = Potential Hydrogen
SC = Specific Conductance--approximates the dissolved-solids content in water.
Alk = Alkalinity
SO_4 = Sulfate
Cl = Chloride
SO_4 + Cl = Total of Sulfate and Chloride

Appendix D
Graphs

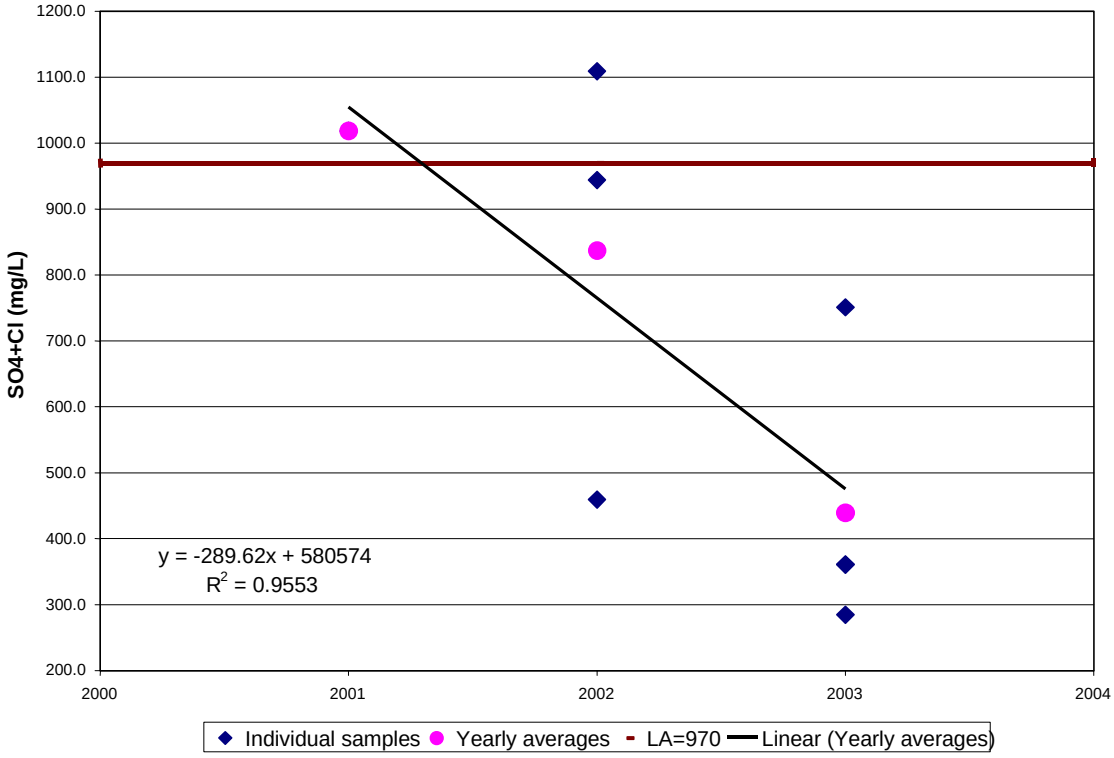
Graph 1: Yearly Average Sulfate + Chloride Concentration Grouped By Site



Graph 2: Sulfate + Chloride concentration measured at site 1



Graph 3: Sulfate + Chloride concentration measured at site 2



Graph 4: Sulfate + Chloride Concentration Measured At Site 3